

Welcome to Earth Matters – field notes on the geology of New Mexico’s enchanting landscapes. – Hydrothermal experiments to probe deep in the Earth’s crust. Celebrating Earth Science Week, I’m Alex Gysi, an Economic Geologist at the New Mexico Bureau of Geology and Mineral Resources and Associate Professor in the department of Earth & Environmental Science at New Mexico Tech.

Many of the metals we use today make our technologies light, efficient, and allow building things that improve our lives and our footprint on the planet. Metals are commonly deposited deep in the Earth’s crust within magmatic-hydrothermal systems. An important ingredient is the presence of hydrothermal fluids, which are like hot water with salt that can carry significant amounts of metals under high pressure and temperature. These fluids play a key role in the transport and concentration of metals in the Earth’s crust to form ore deposits. To understand these ore-forming processes we can either inspect rocks and fluid inclusions that represent ancient fossilized geologic systems, or we can mimic these fluids in the lab...

In the Ore Deposits and Critical Minerals lab at New Mexico Tech we study the behavior of metals deep in the Earth’s crust. We synthesize minerals such as fluorite, calcite, and apatite, or observe fluids under pressure and temperature. We use, for example, hydrothermal reactors in which we can cook up fluids and synthesize minerals that we dope with rare earth elements. We then study their structure and compositions using X-ray to determine how they are affected by temperature, fluid chemistry, and other parameters. Another type of experiment is called “diamond anvil cell”, which essentially consists of pressing two diamonds together in which sits a gasket and a tiny sample of fluid and mineral, generally tens of micrometers. These are called *in situ* because we can probe fluids and minerals using Raman spectroscopy at very high pressures and temperatures in the cell without destroying the sample during an experiment. We are talking about 5 to 20 kbar, which is 5000 to 20,000 times the pressure we feel on the Earth surface! The temperatures are also well beyond the boiling point of water, up to 600 degrees Celsius! Our lab is pretty unique in the U.S. and we conduct frontier research focusing on understanding rare earth elements and other critical minerals in hydrothermal fluids.

Celebrating Earth Science Week, I’m Alex Gysi.